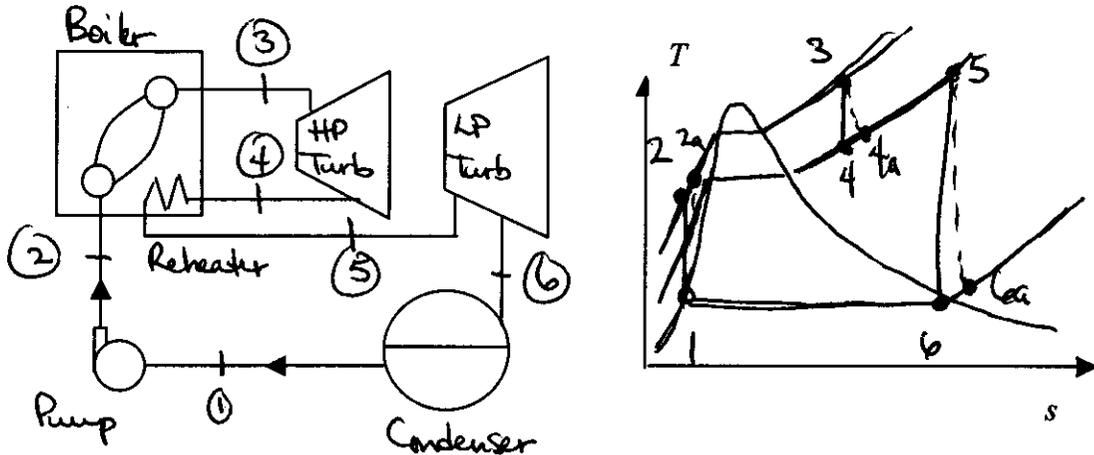


Example Problem - Rankine Cycle with REHEAT

Consider a Rankine Cycle operating with a condenser pressure of 25kPa and a boiler pressure of 12.5 MPa. Steam enters the high pressure (HP) turbine at 800 C and exits at a pressure of 5MPa. The steam from the HP is reheated to a temperature of 800 C before entering the low pressure (LP) turbine. The isentropic efficiency of the pump is 85%, and the both turbines have an isentropic efficiency of 95%. Assume that both the turbine and compressor are still adiabatic.

a) Label each component and state point. Sketch the Rankine cycle on a $T-s$ Diagram



b) Complete the following table of the thermodynamic properties

State	Pressure	Temperature	h (kJ/kg)	s (kJ/kg)	Phase Description
1	25 kPa	64.97	271.9	0.8931	Saturated Liquid
2s	12,500 kPa	*****	284.6	0.8931	Compressed Liquid
2a	12,500 kPa	*****	286.9	0.8996	Compressed Liquid
3	12,500 kPa	800	4103.6	7.2965	Superheated Vapor
4s	5000	614.8	3701.1	7.2965	Superheated Vap
4a	5000	640.6	3761.4	7.362	Superheated Vap
5	5000	800	4137.1	7.7440	Superheated Vap
6s	25	64.97	2588.7	7.7440	Sat Mixture
6a	25	*****	2666.1	*****	Superheated Vap

c) Given a mass flow rate of 100 kg/s determine the output power of the plant (kW).

$$w_T = h_3 - h_{4a} + h_5 - h_{6a} = 1813.2 \text{ kJ/kg}$$

$$w_p = -14.9 \text{ kJ/kg}$$

$$w_{net} = 1798.3 \text{ kJ/kg}$$

d) What is the thermal efficiency of this cycle?

$$q_{in} = h_3 - h_{2a} + h_5 - h_{4a}$$

$$q_{in} = 4192.4 \text{ kJ/kg}$$

$$\eta_{th} = \frac{w_{net}}{q_{in}} = 42.9\%$$

$$W_{net} = 179,830 \text{ kW}$$

